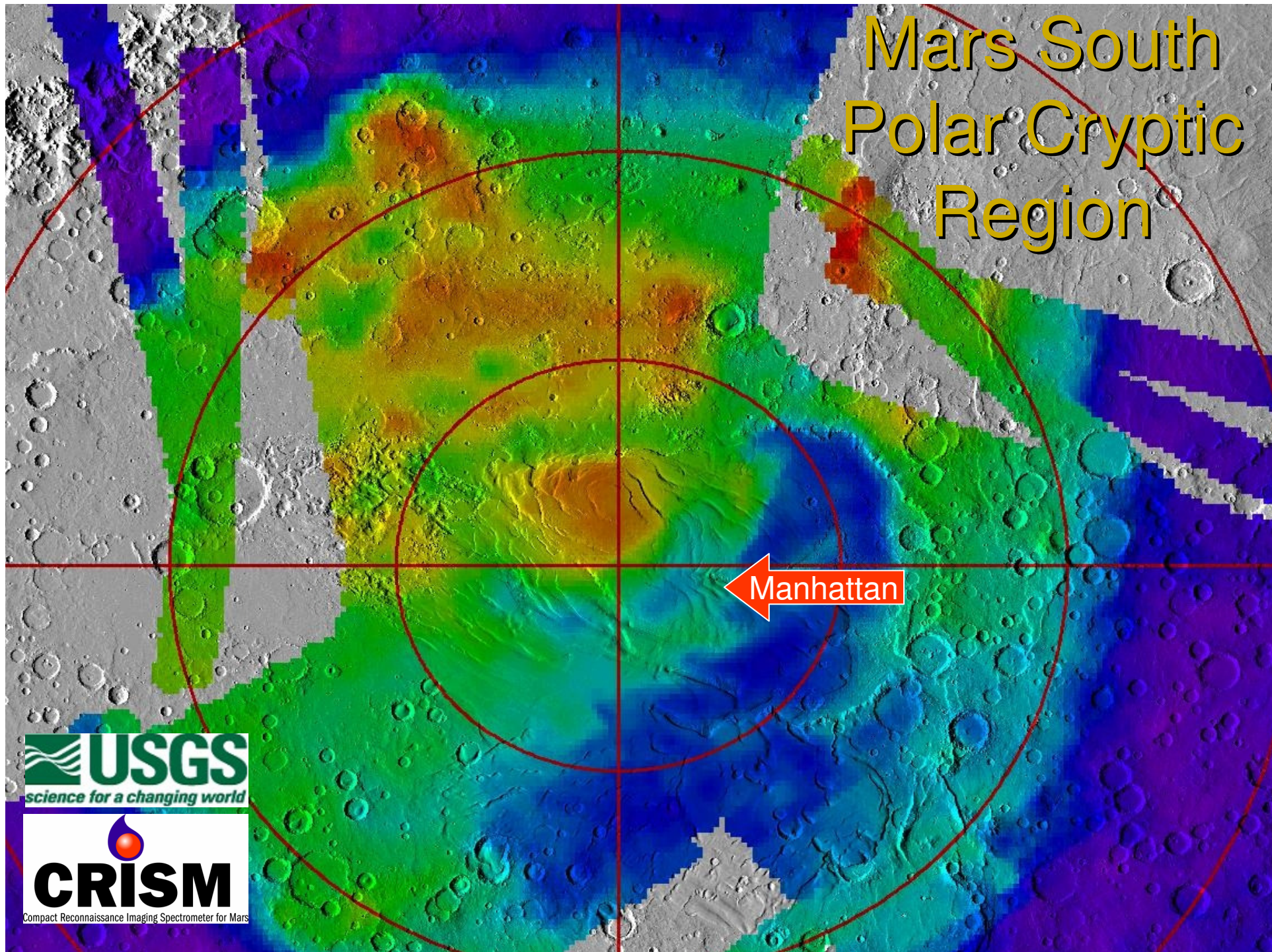


# Mars South Polar Cryptic Region

Manhattan

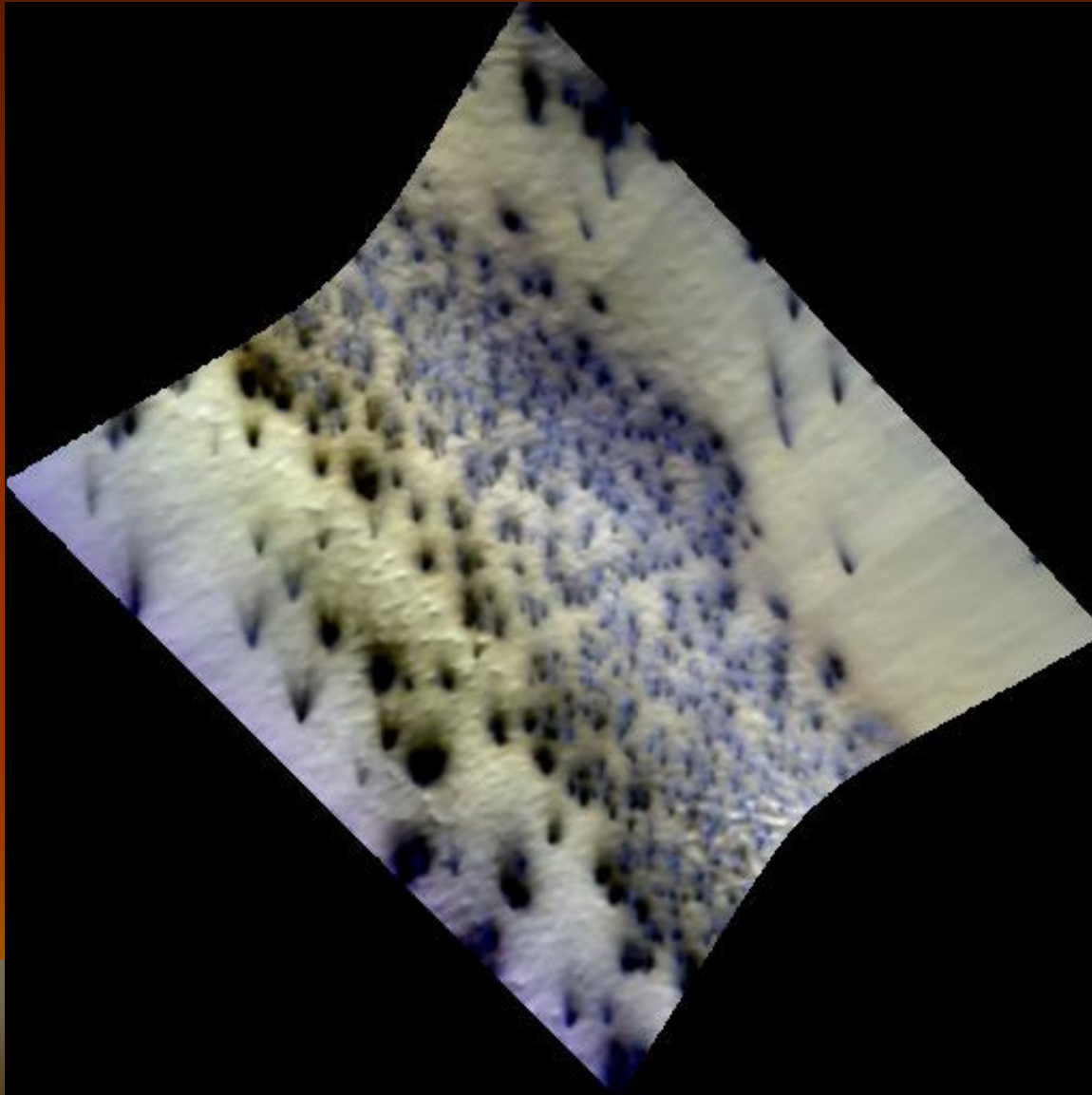
**USGS**  
science for a changing world

**CRISM**  
Compact Reconnaissance Imaging Spectrometer for Mars

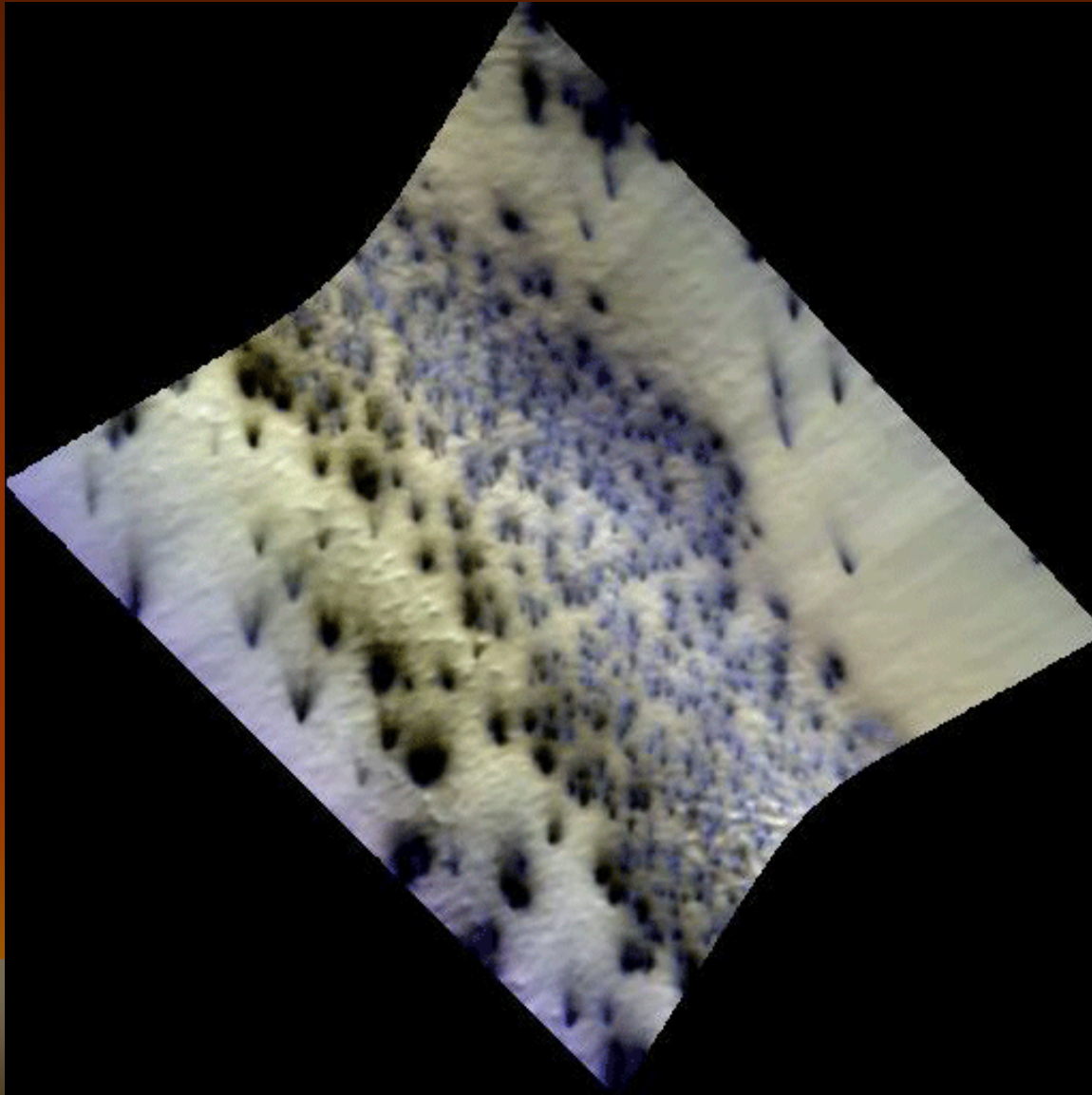




# Edge of Manhattan Island



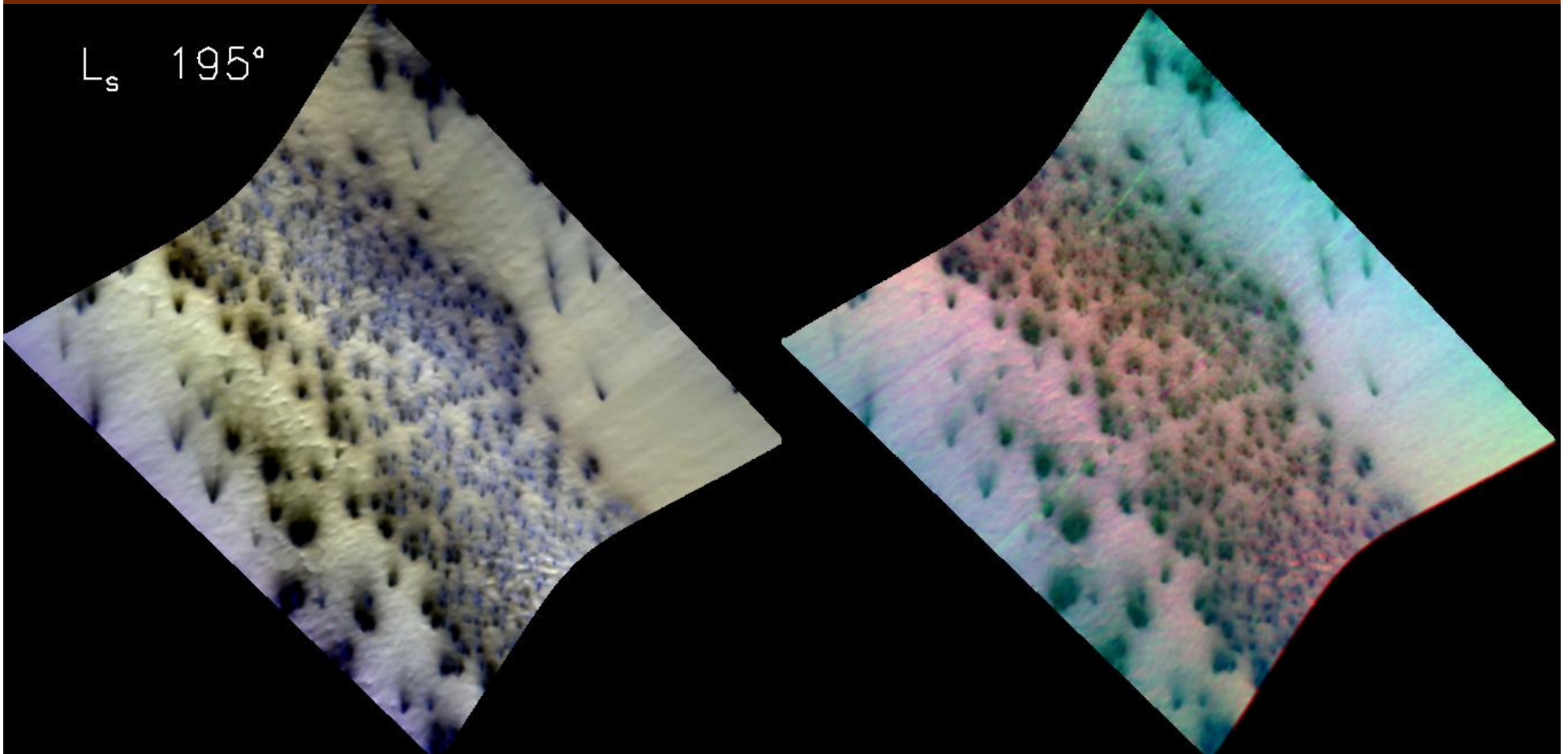
# Edge of Manhattan Island



# Edge of Manhattan

- Magenta → Bright CO<sub>2</sub>
- Greenish → H<sub>2</sub>O Contamination
- Black → Surface Dust

L<sub>s</sub> 195°

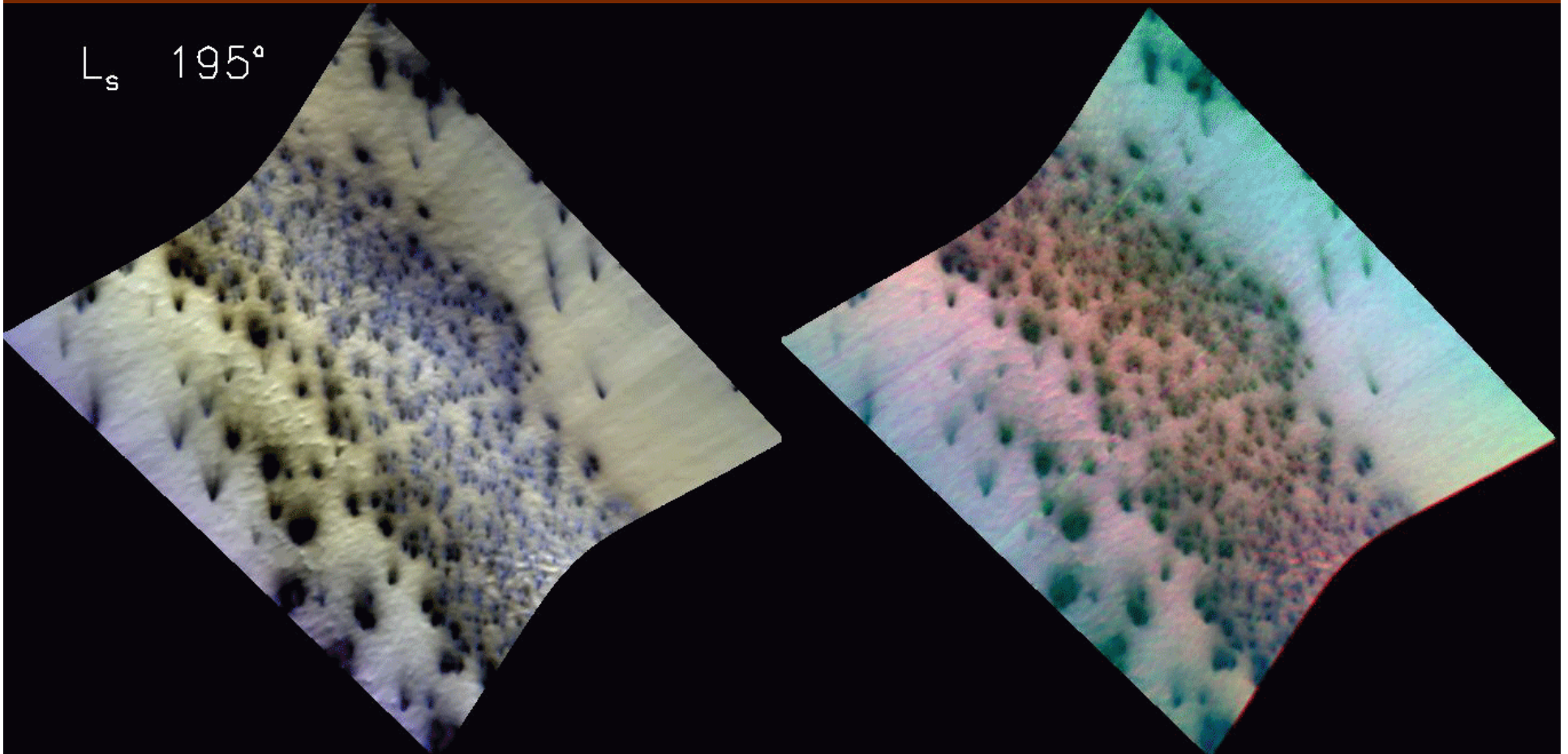




# Edge of Manhattan

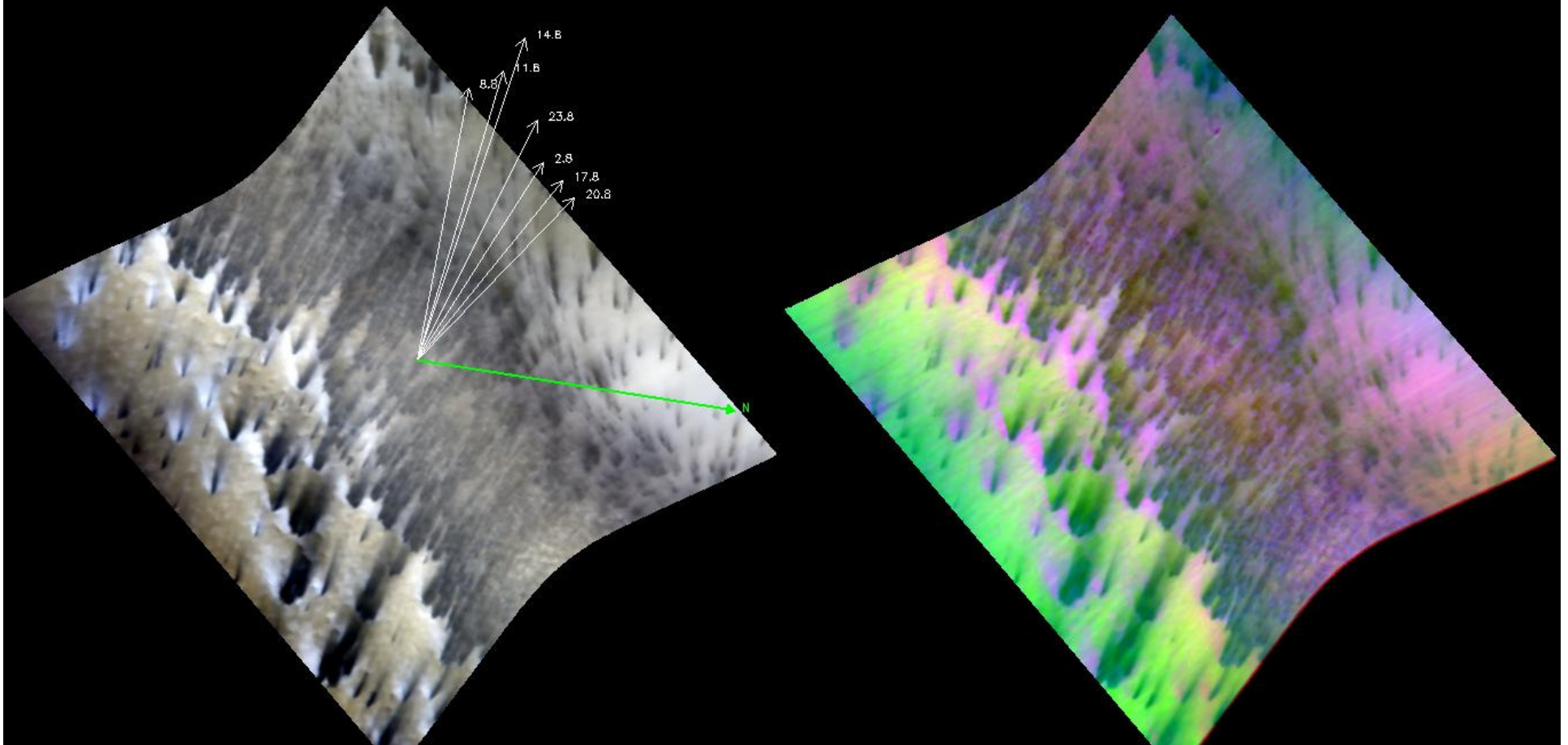
- Magenta → Bright CO<sub>2</sub>
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L<sub>s</sub> 195°



# Edge of Manhattan

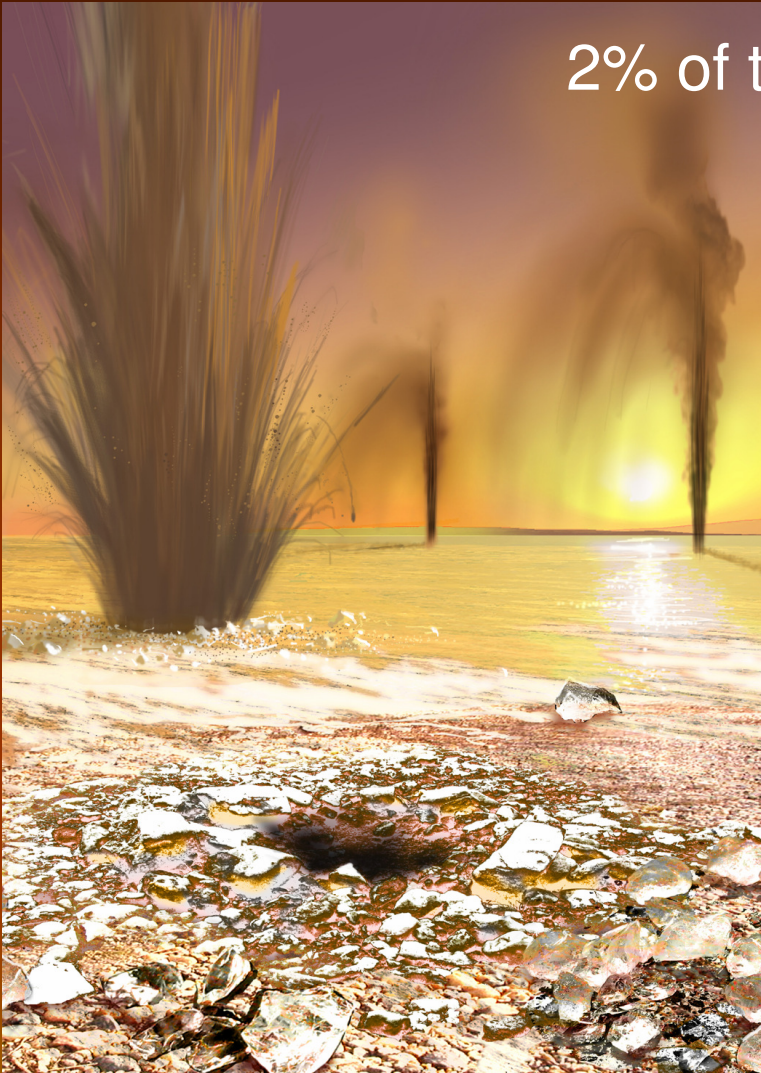
- Magenta → Bright CO<sub>2</sub>
- Greenish → H<sub>2</sub>O Contamination
- Black → Surface Dust



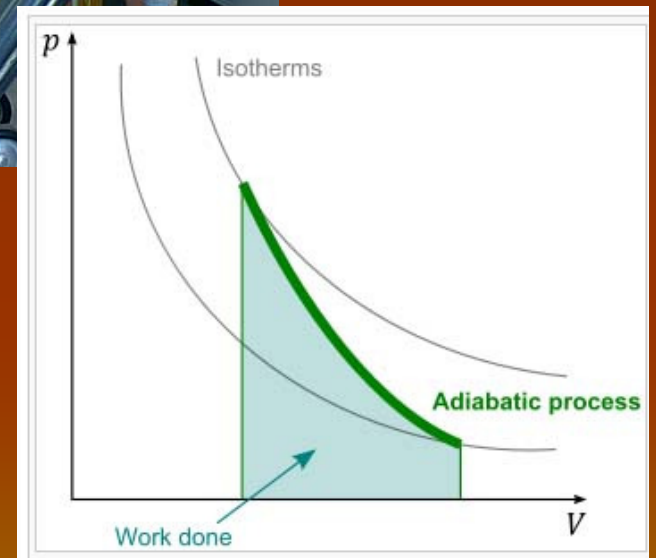


# White Fans: A New Model?

2% of the Gas can be converted back to frost.



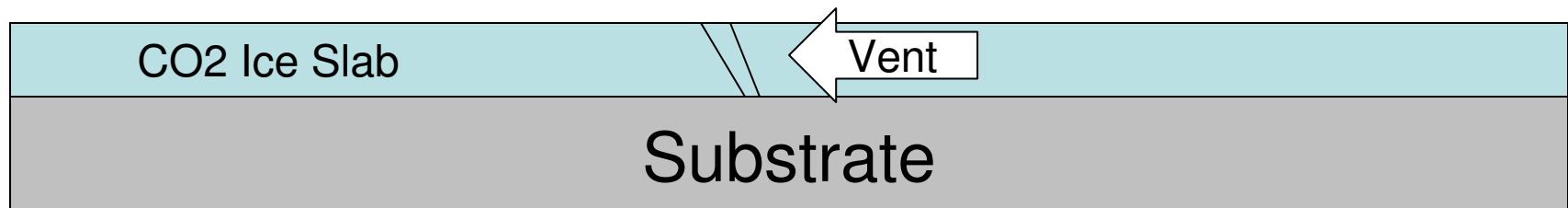
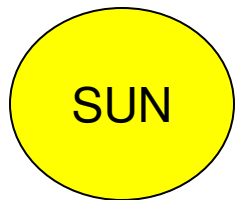
## Adiabatic Cooling



Credit: Ron Miller,  
Arizona State University

Early Morning

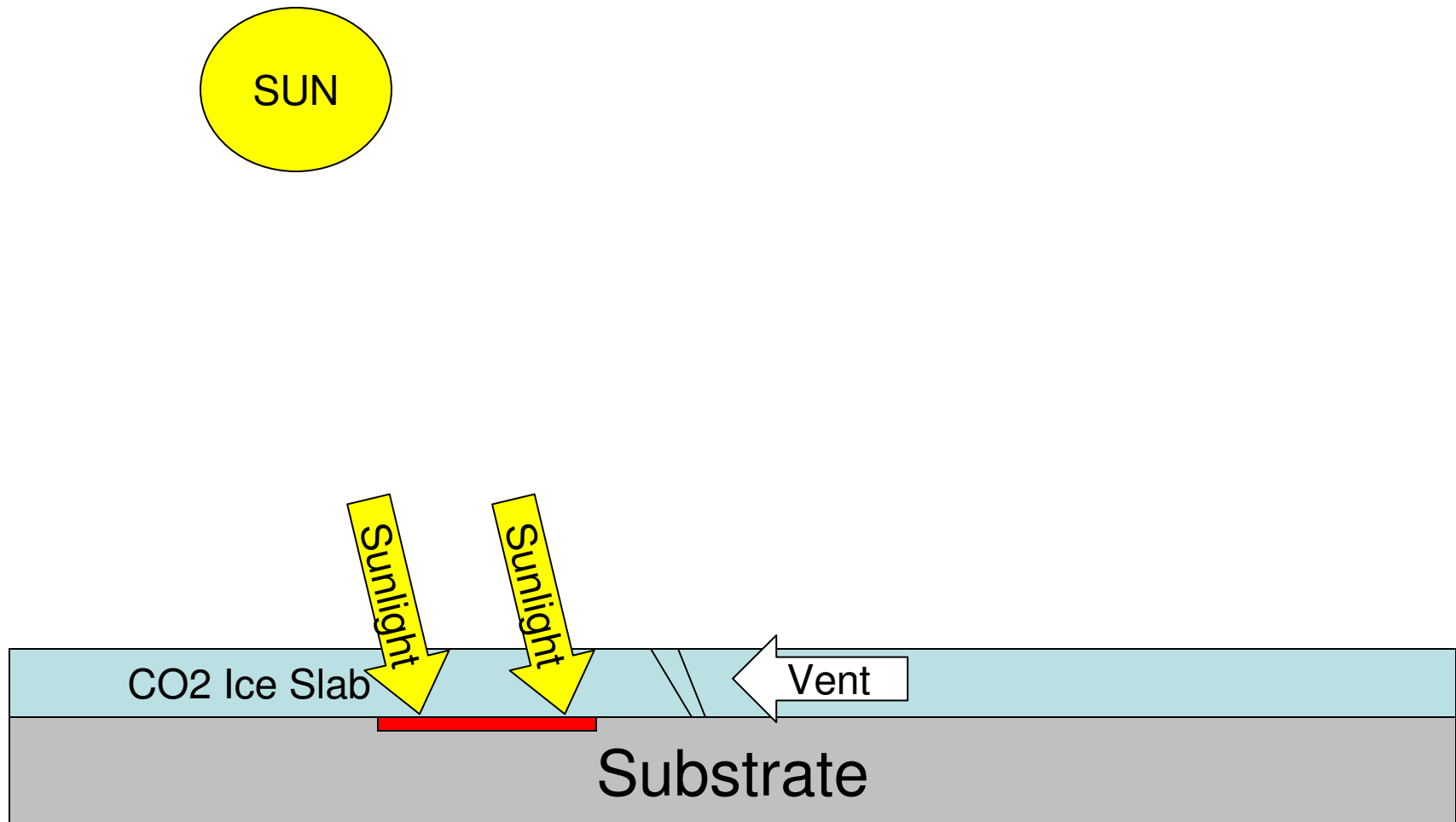
Sun is low on the horizon so little heating of the substrate occurs.





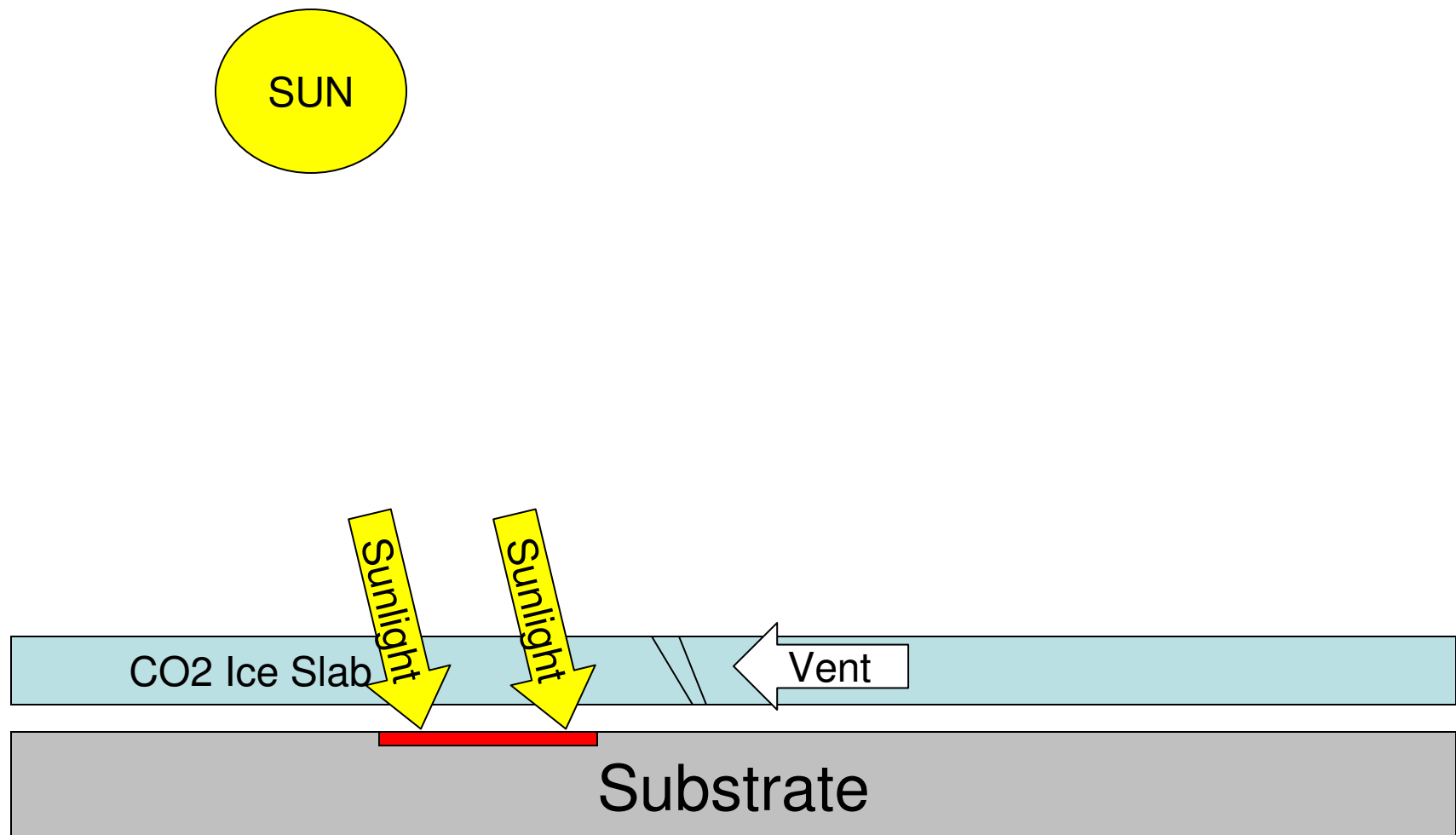
Mid Morning

Sun is higher in the sky. Sunlight shines through the CO<sub>2</sub> ice, heating the underlying substrate.



Mid Morning

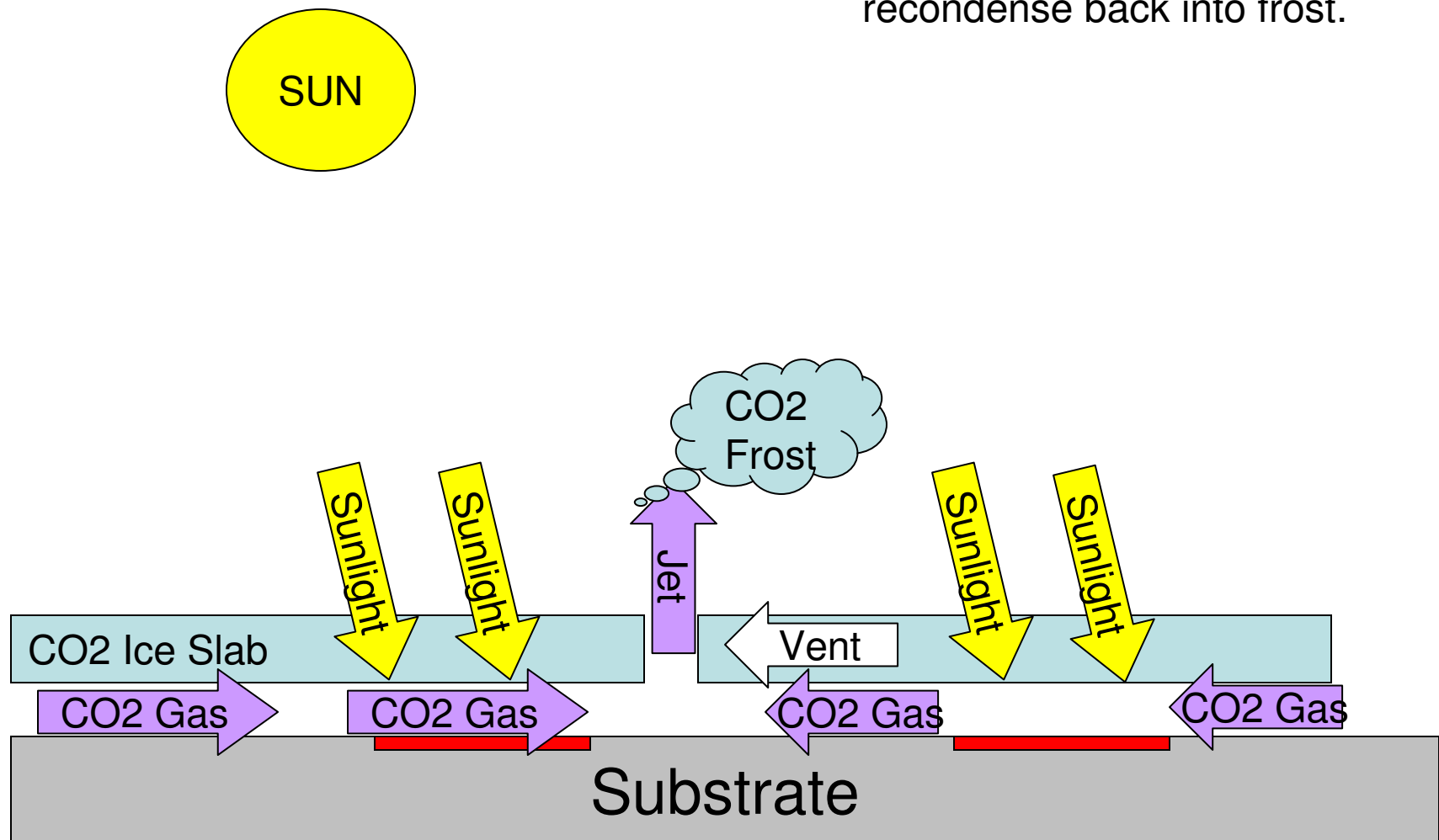
As the sunlight heats the underlying substrate, the CO<sub>2</sub> slab ice starts to sublime from the bottom, thus building up pressure and causing the ice slab to levitate.





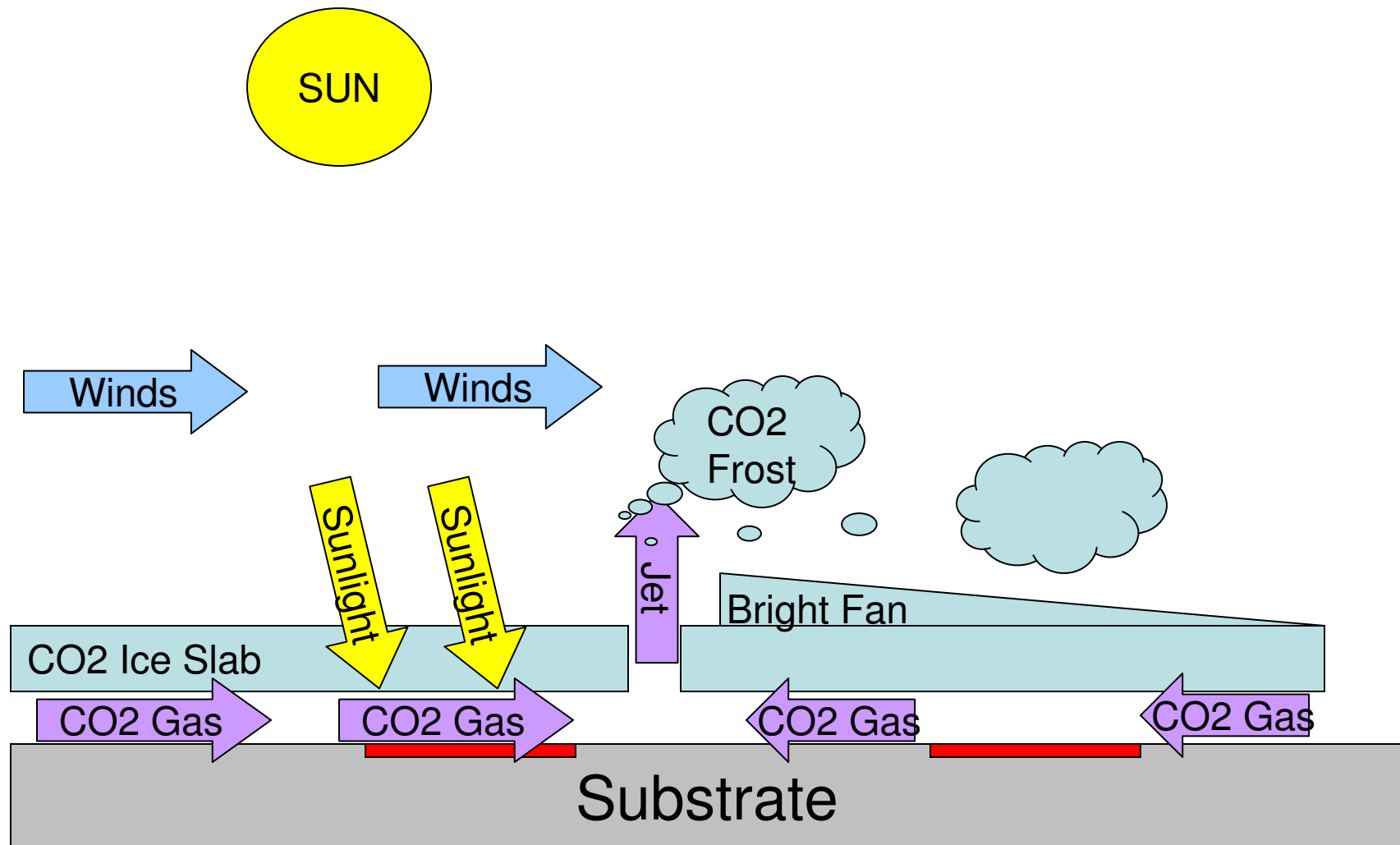
Mid Morning

Sunlight continues to heat the underlying substrate, until the pressure breaks through the CO<sub>2</sub> slab ice, causing a jet of gas to expand and cool. This cooling causes some of the gas to recondense back into frost.



Mid Morning

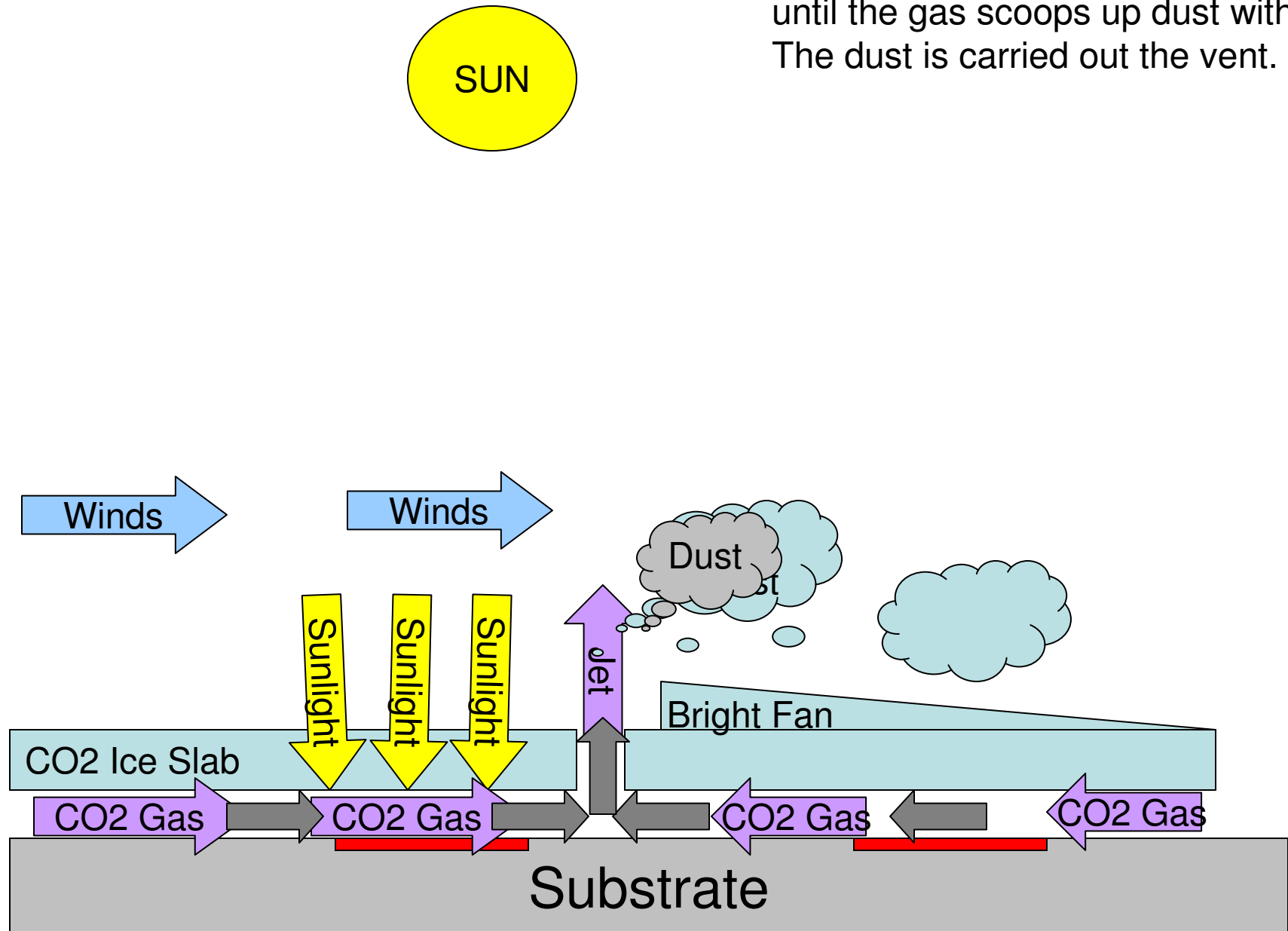
Winds blow the recondensed frost downwind, where some of the frost settles to the surface, forming bright fans.



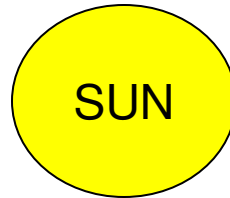


Late Morning

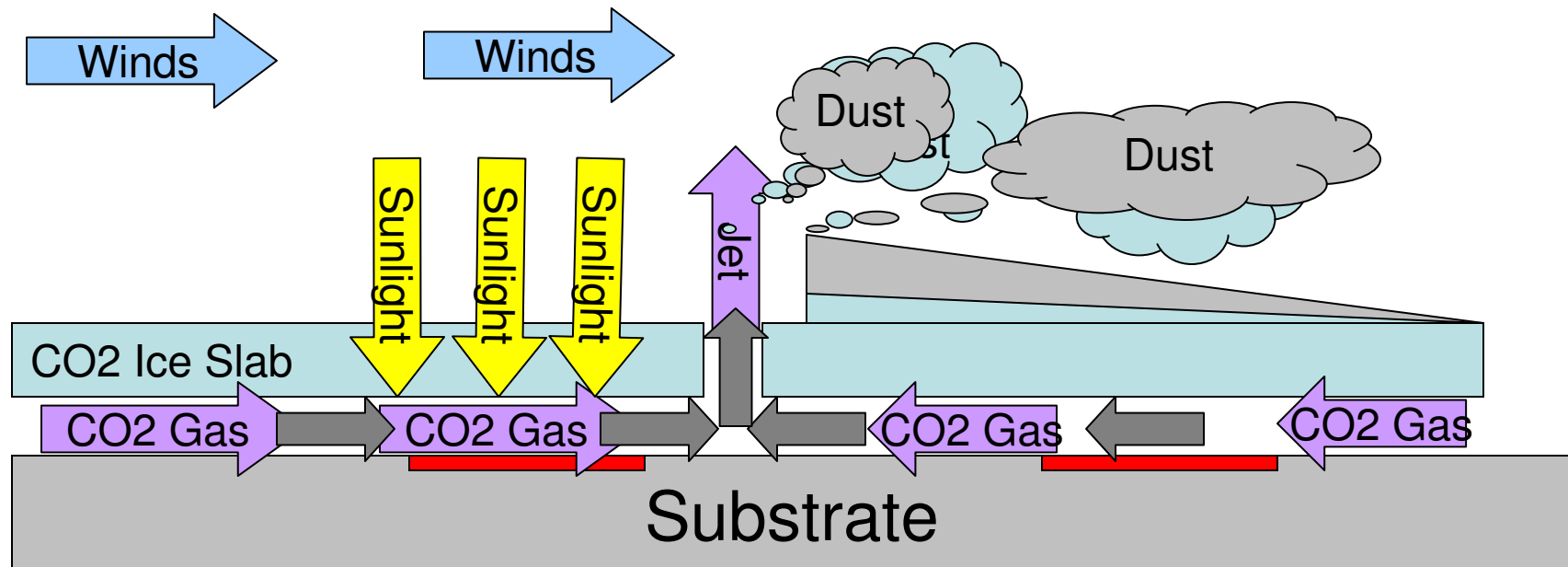
As the sun rises higher in the sky,  
the gas under the ice picks up speed,  
until the gas scoops up dust with it.  
The dust is carried out the vent.



Mid-Day



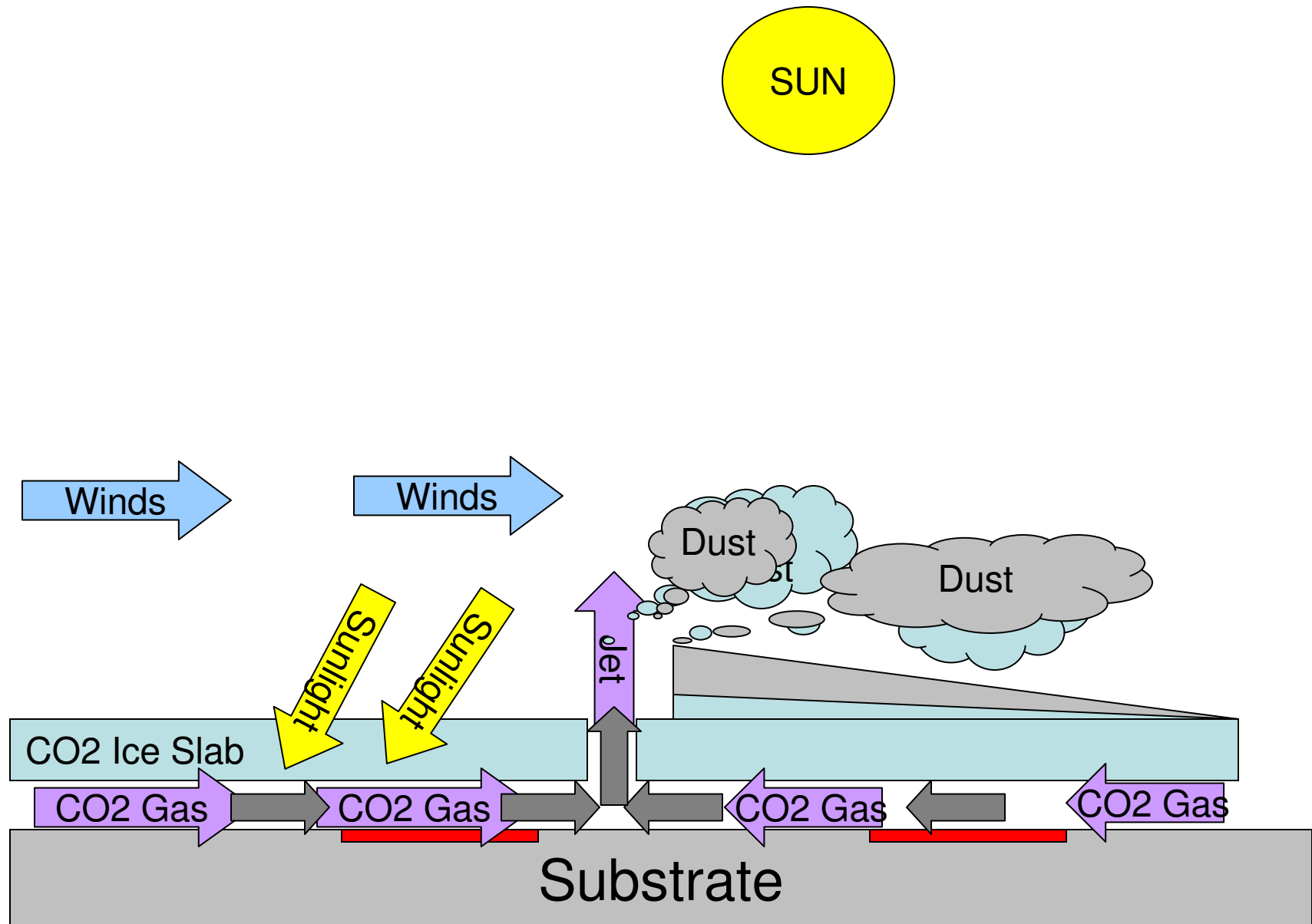
When the sun is highest in the sky, the gas under the ice is at full speed. Dust and gas spew from the vent. The dust is blown downwind and settles on the ice slab, forming a dark fan.





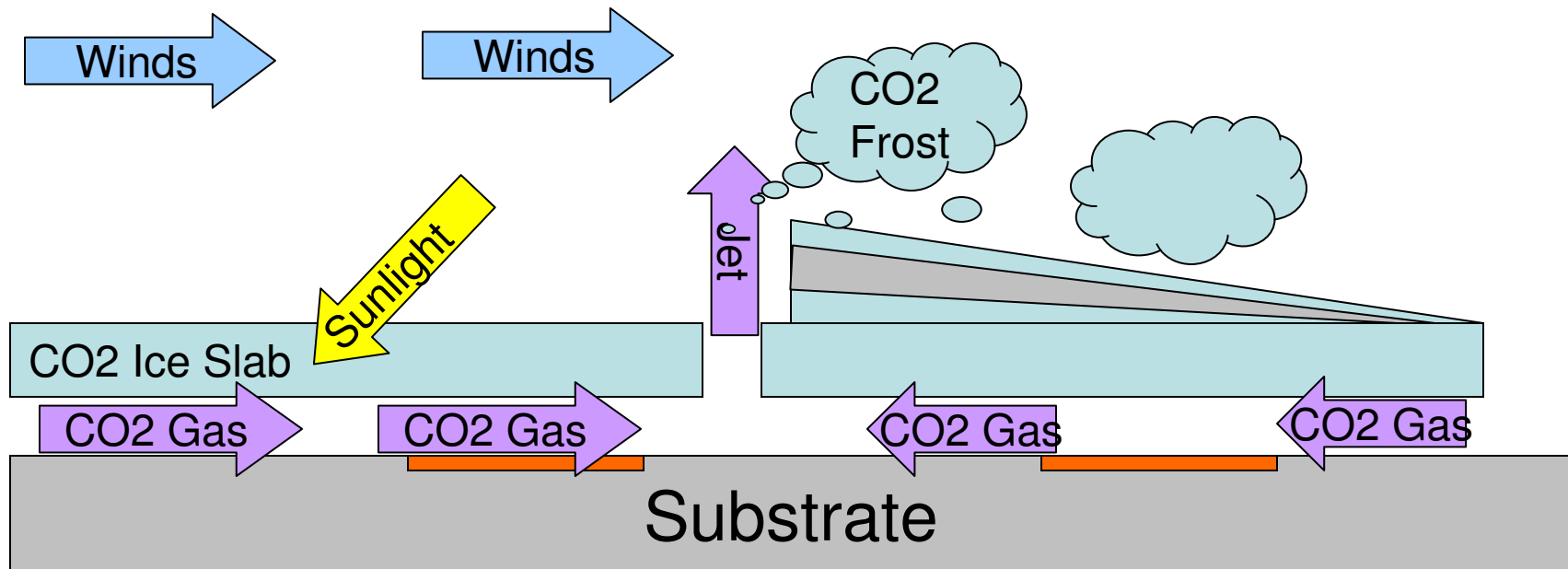
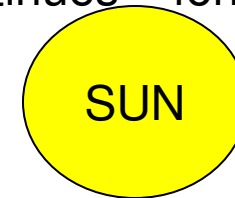
Early Afternoon

This process continues through early afternoon.



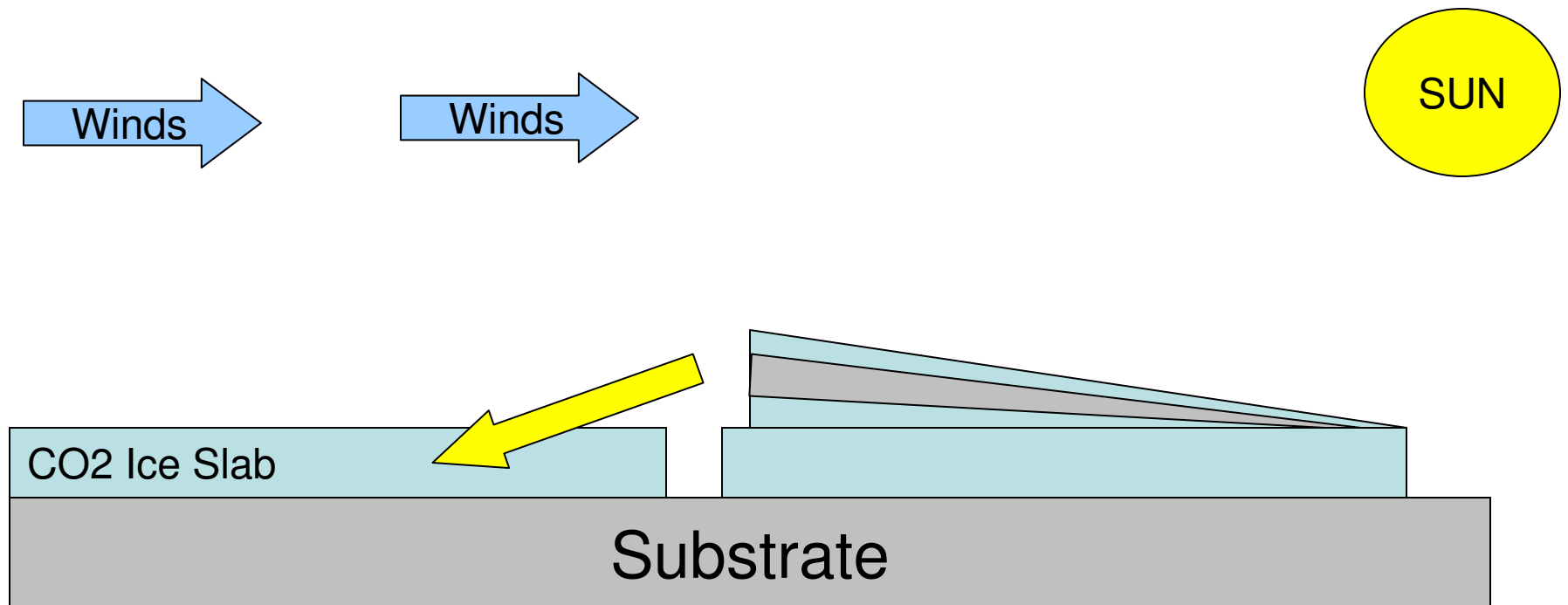
Mid Afternoon

By mid-afternoon, the sun has sunk low enough there the substrate begins to cool and the gas pressure decreases to the point that the dust can no longer be scooped up and shot out of the vent. Adiabatic Cooling continues – forming more white fans



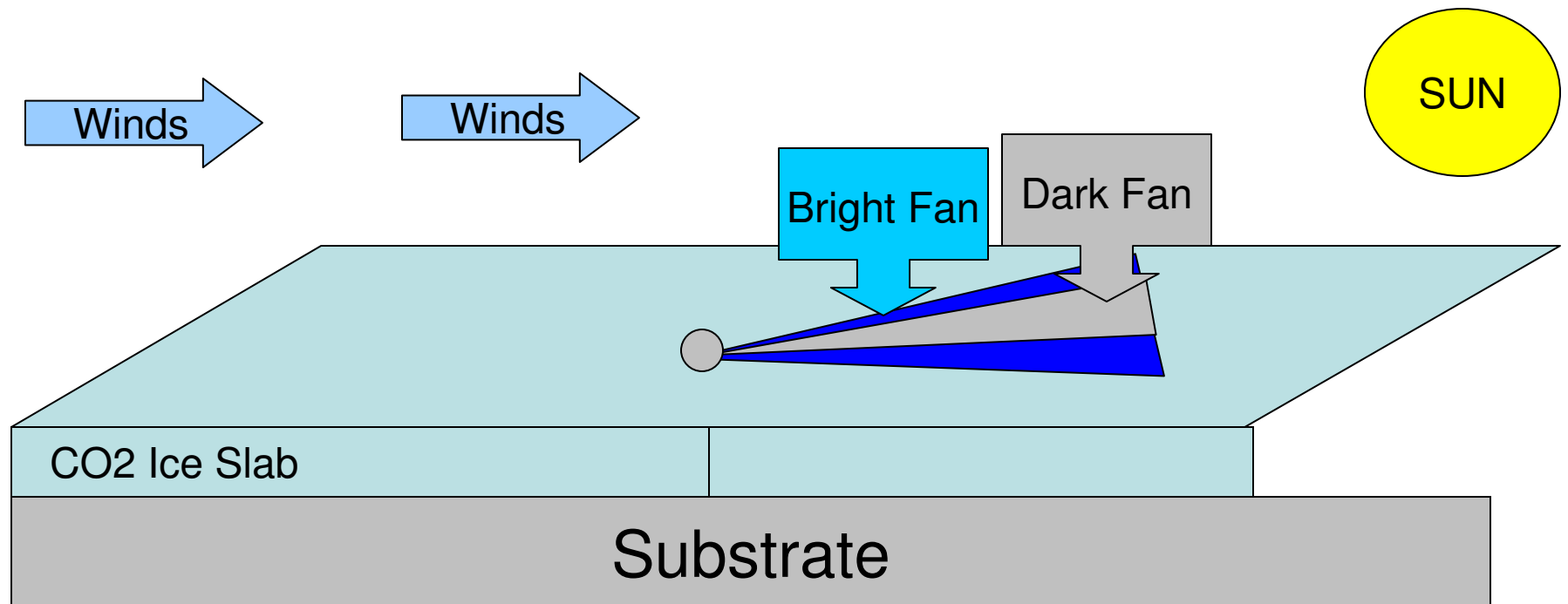
Late Afternoon

By late afternoon, the sun has sunk low enough that the substrate has cooled back to CO<sub>2</sub> frost temperatures and the gas pressure under the ice slab has returned to atmospheric levels. The whole venting process has stopped.



Late Afternoon

At the end of the day, all we have left are the fans.





# Summary

- **Bright fans**
  - are CO<sub>2</sub> frost which forms due to adiabatic cooling.
  - are seen at many vents in mid-spring.
- **Dark fans**
  - form when jets are under highest pressure.
  - must cover up white fans.
- **Variable wind speeds/directions of fans suggest dark fans form during mid-day.**



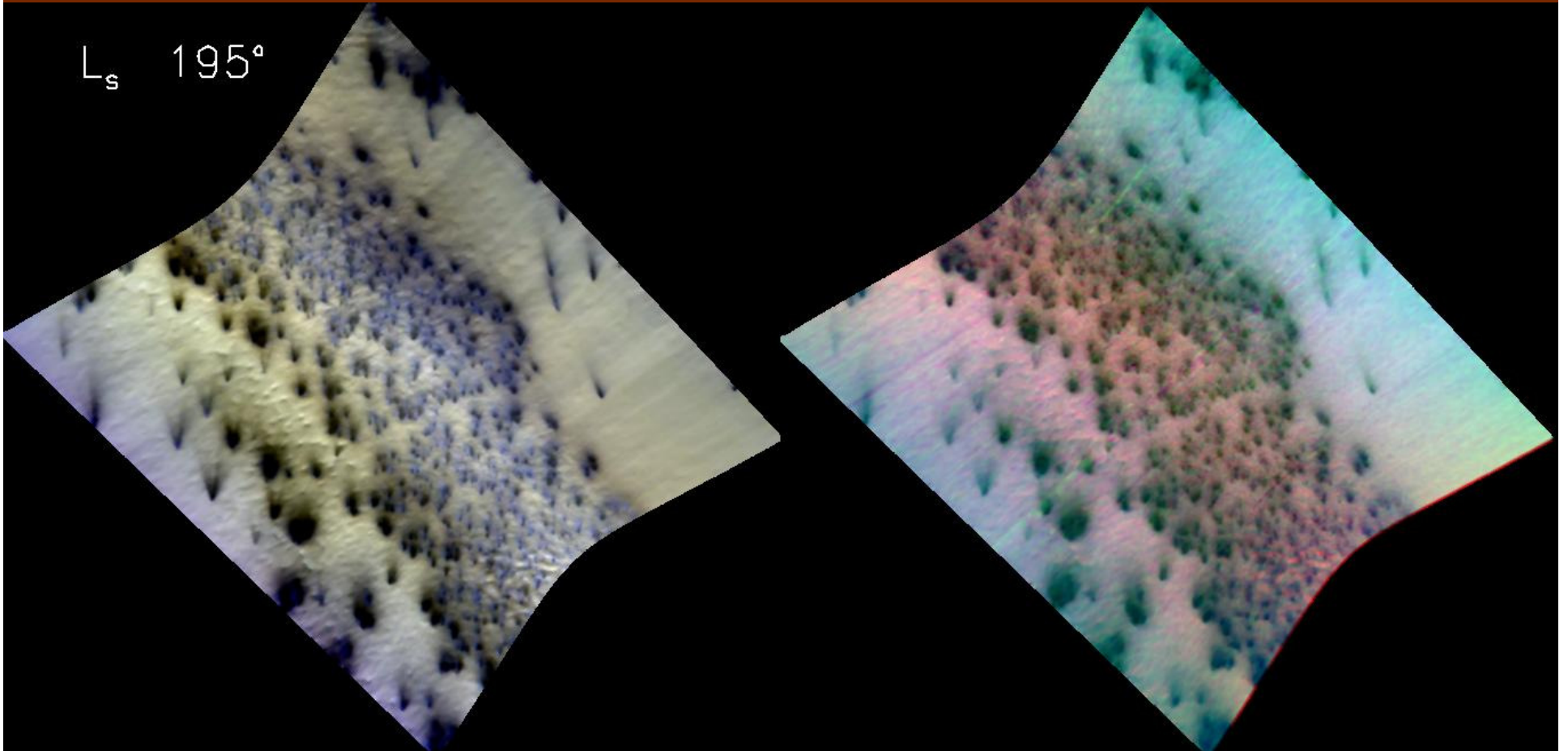
# The End

- Extra Slides Follow
  - Manhattan: Frame by Frame
  - A day in the life: Frame by Frame
  - Giza: The Movie



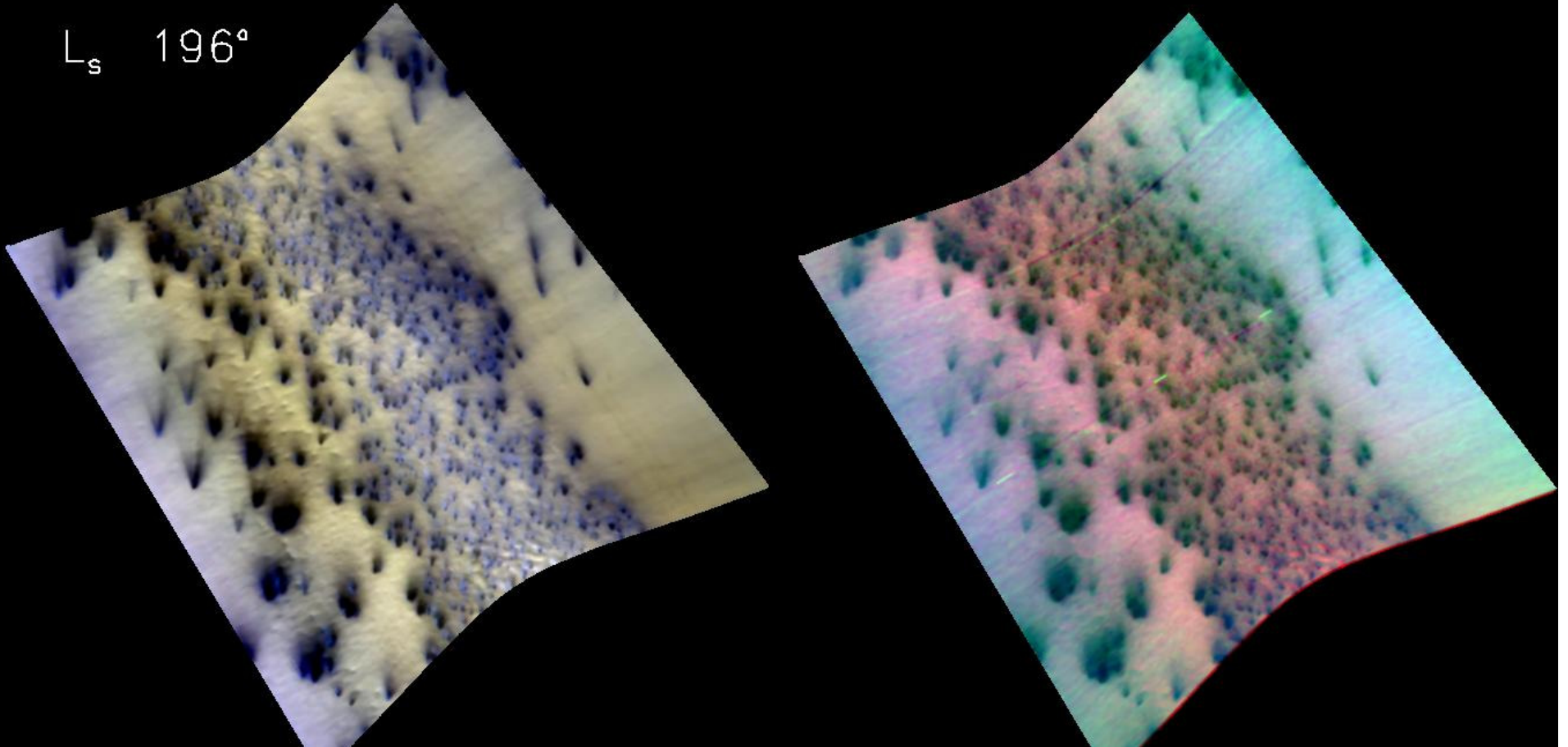
# Edge of Manhattan

$L_s$  195°



# Edge of Manhattan

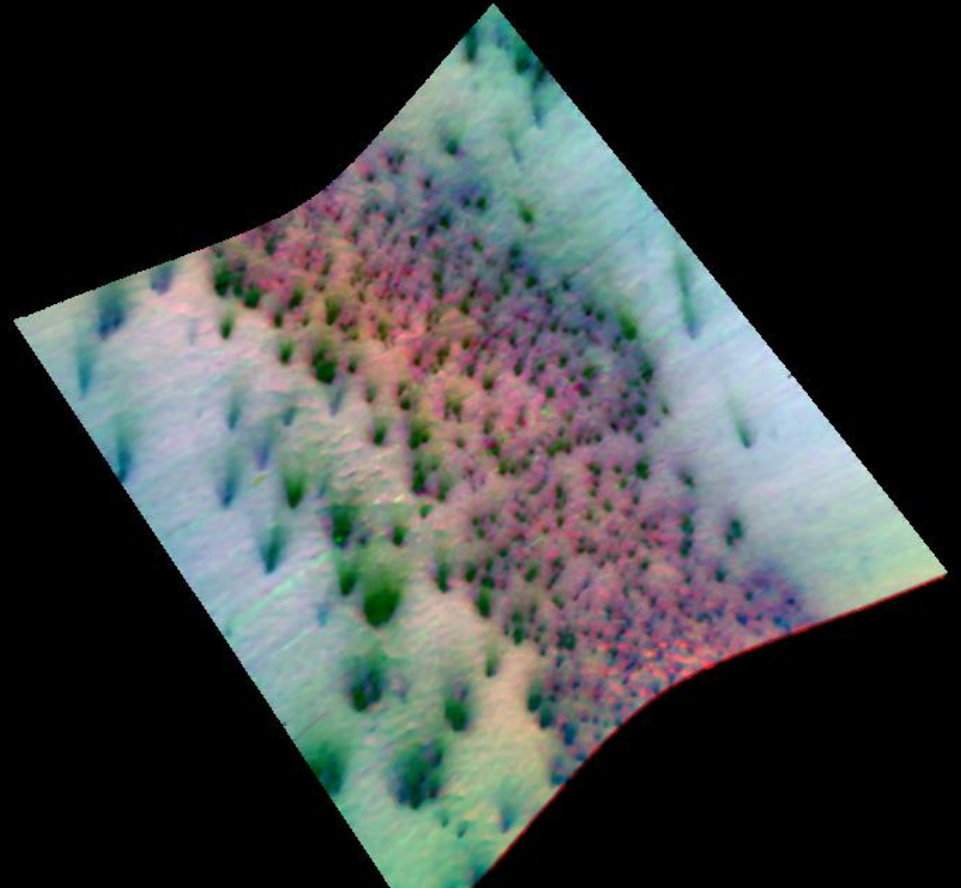
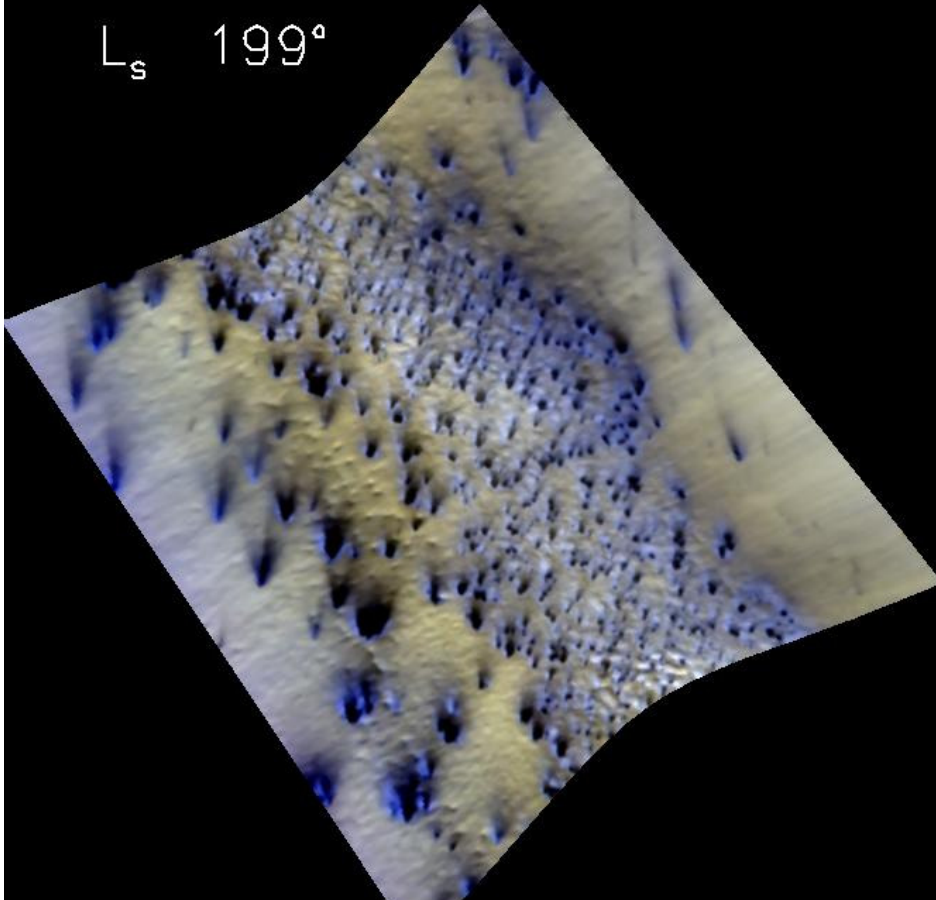
$L_s$  196°





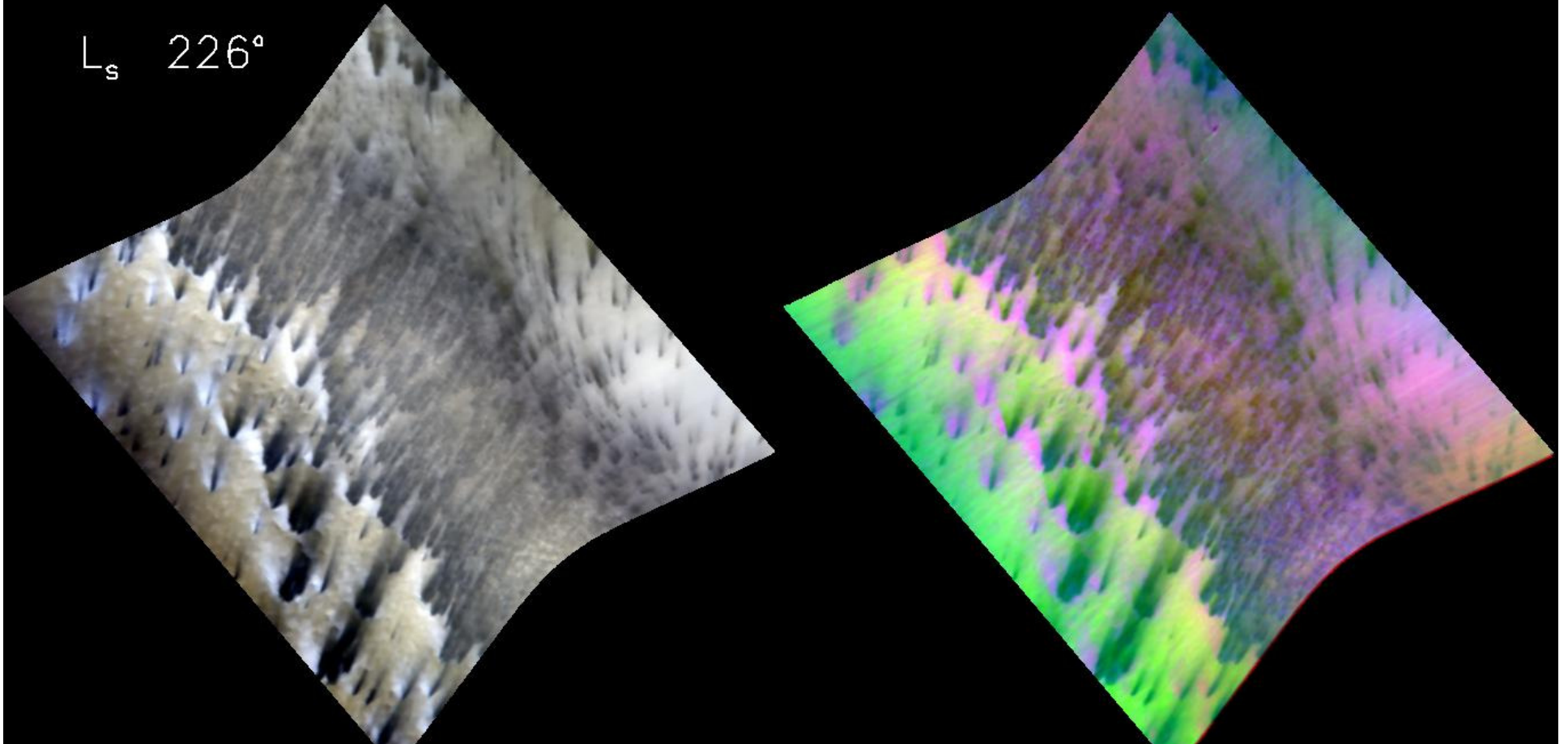
# Edge of Manhattan

$L_s$  199°



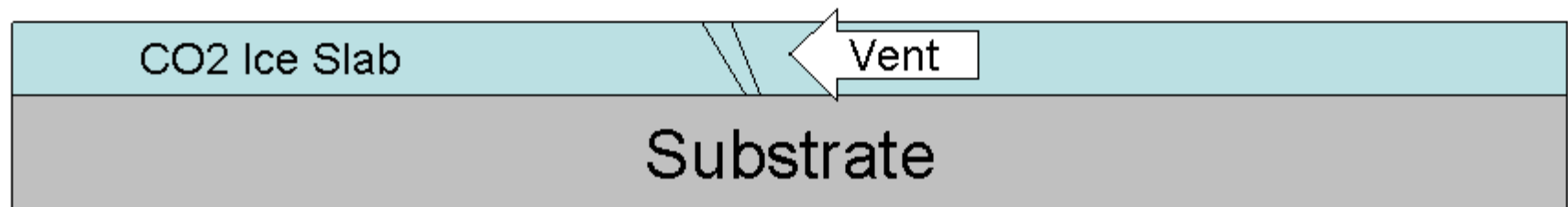
# Edge of Manhattan

$L_s$  226°



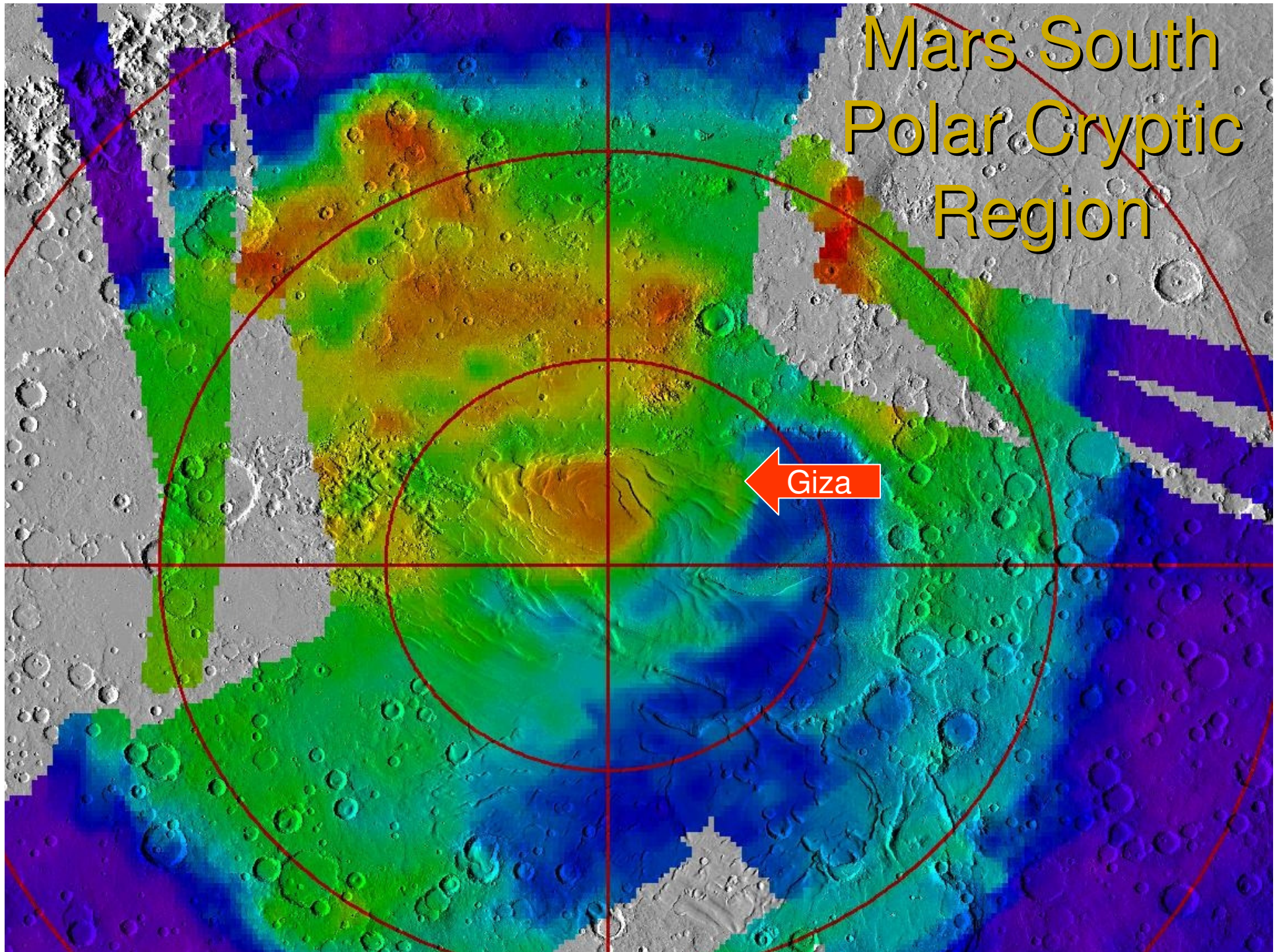
Early Morning

Sun is low on the horizon so little heating of the substrate occurs.





# Mars South Polar Cryptic Region





# Giza

$L_s$  181°

